Consumer Issues Relating to Products from New DNA-Editing Techniques

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I run the Biotechnology Project[1,2] at the Center for Science in the Public Interest. I've been with CSPI for over 13 years, during which time the Biotechnology Project has issued a number of statements about genetically engineered (GE) crops and animals. CSPI has said that we have looked at the data behind the crops that are grown in the United States and that foods made from those crops are safe to eat. I don't know of too many consumer organizations in the United States or around the world that have said that, but this is what the scientific evidence shows. Also there are benefits from those crops, to farmers and to the environment, although not necessarily any direct benefits to consumers as of now. However, CSPI does advocate for each GE product to be assessed on a case-by-case basis. The Biotechnology Project works to make sure that we have functional regulatory systems that ensure safety but allow safe products to be marketed. Also, it is important that biotechnology products are used in a sustainable manner so that they are available to future generations of farmers.

Consumers

When you talk about food and consumers, the primary concern is safety. As a parent, I want to know that the food I choose at the supermarket is safe. But safety is not the only consideration that consumers have about food: it must also be healthy and nutritious, and taste is important. Also, food serves other objectives for many people. Cultural forces help define our interests in certain food. You tend to eat what you were brought up

[1]https://www.cspinet.org/biotech/.
[2]http://cspinet.org/images/biotechbrochure.pdf.

eating. Tradition is important. So too is religion. Food is used in many religious celebrations. There is a strong social aspect to food—we don't eat just for calories and nutrition. I mention these considerations because sometimes scientists think that they can rely simply on rational, factual, and scientific arguments when talking to consumers about food. Recently, I attended a meeting at which it was suggested that *in vitro*-cultured meat will be attractive to consumers in the future. Scientifically, it may be the best thing for us, but consumers may have reasons to avoid it. It's important to realize that consumers do not always make food choices that are rational or based on science. For example, a consumer may buy organic produce for health reasons, but also purchase a 6-pack of soda or a huge piece of beef.

I do think that consumers—some more than others—care about the impact their choices, including what they eat, may have on the environment. Some young people are expressing that they are choosing agriculture as a career for environmental reasons. But, when discussing the environment, it is important to appraise new technology in comparison with current practices in a comparative analysis, as opposed to a definitive determination of whether it is good or bad for the environment.

Some consumers know a lot of about science, whereas some don't know much at all. I mention this because, again, scientists and others involved in scientific careers sometimes think that, if they just talk about science more clearly, people will understand them better. Another consideration is that various sources of scientific and non-scientific information are available, notably from the Internet, government, and scientific institutions. Consumers also receive information from opinion leaders whose viewpoints they consider important. Those opinion leaders may be with NGOs or universities. They could be politicians or academically qualified neighbors. That is important to understand because a lot of people will rely on opinion leaders to tell them what they think about these new technologies.

For some consumers, if they strongly believe something, scientific data and reasoned argument may not change their minds. You can talk to them in-depth about the evidence but it may make no difference to them, especially if it addresses a particular food preference they have.

These are all things to think about as these new DNA-editing techniques move forward to produce products and as you communicate with the general public about them.

New and Old DNA-Manipulation Techniques

CSPI has stated that current GE plants are safe and beneficial. That is the international consensus among scientific institutions and government agencies who have looked closely at the issue. Those GE crops have been met with farmer acceptance worldwide, but not necessarily with consumer acceptance.

A couple of new GE crops are on the horizon. The Arctic® apple is non-browning and the Innate™ potato is also non-browning and has a low acrylamide content when fried. The developers of both of those products used "endogenous" DNA, which means they used the crops' own genetic material instead of creating a transgenic organism by using DNA from a different species. The developers believe that there will be much more of a positive acceptance by consumers due to this difference. However, when one looks at the

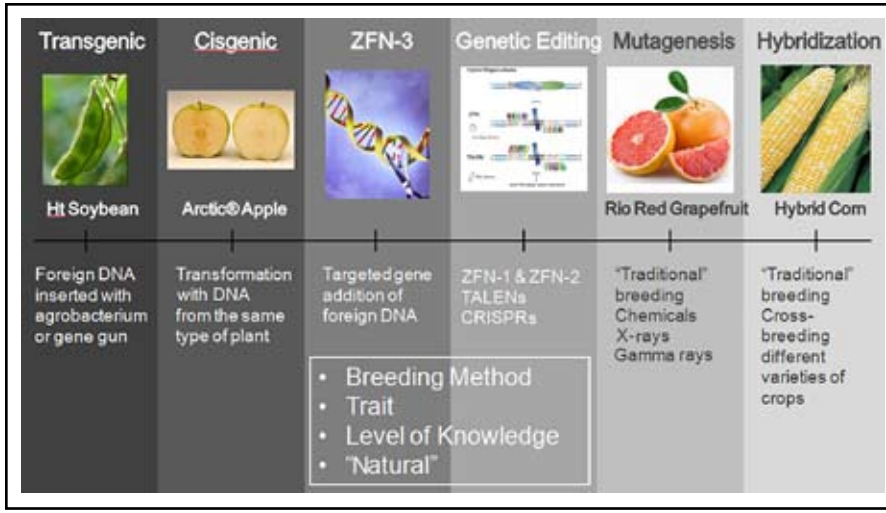

Figure 1. Selected methods of improving crops.

comments sent to USDA, many NGOs and academics who have been against transgenic crops are not making that distinction. Their comments are just as negative for the GE apple or potato as they are for transgenic corn or soybean plants.

The question is, "What will consumers do?" Will they believe those academics and NGOs as their opinion leaders? Will they listen to the producers and others who say these are different from transgenic products and are less risky? I don't know the answer.

A few articles have been published in scientific journals about gene-editing techniques and how they might be perceived by consumers and regulated by the government. The consensus of those articles is that it would depend on whether exogenous DNA or endogenous DNA is involved. The authors honed in on this idea that as long as you are working within the plant's own genome it should be regulated differently and potentially have greater consumer acceptance. I don't think it's so simple; I don't think it's going to be so binary.

Figure 1 shows a number of techniques for crop improvement that scientists currently use on a continuum.

On the far left of Figure 1, there are transgenic plants. Then come cisgenic plants (such as the GE apple and potato). In the middle, there are zinc-finger nuclease (ZFN) -3, and other DNA-editing techniques, including ZFN-1 and -2, TALENs and CRSPRs. Then, on the right, there are "traditional" forms of breeding, including mutagenesis—chemical and radiation—and hybridization. I believe that when consumers look at these technologies they are not going to appraise them simply on whether they contain introduced DNA from a different species. I think it is more complicated. They are going to consider, *inter alia*, the breeding method, the specifics of the trait, and the level of knowledge about the technique. Most consumers know nothing about mutagenesis, for example; if an organization decided to inform consumers about the crops they eat that were developed

with mutagenesis, many consumers might end up being concerned. CSPI conducted a consumer opinion poll some years ago asking consumers if they wanted "hybridized" on the label of foods containing corn and more than 50 percent said "yes." Most consumers do not say "no" to questions asking if they want more information. What the answer shows, however, is that people didn't know what hybridized corn is, because virtually all the corn we eat comes from hybrid seeds. So, whether something is perceived as "natural" could also determine consumer perspectives.

Factors for Consumer Acceptance

What, then, are the factors that influence consumer acceptance when looking at new technologies to produce food crops? Number one is safety. Consumers want to know who is ensuring safety. And they are likely to seek information about safety from opinion leaders they find credible, which could be government officials, representatives of trusted NGOs, or academics. Universities like Cornell and their faculty have a role to play as trusted opinion leaders on issues like this. Consumers want to understand how much is known about the process and the product; accordingly, the scientific knowledge of the consumer is important, particularly in terms of how the product compares to other similar products.

Many consumers may consider who benefits from the products. Corporate control is a factor that has adversely affected acceptance of GE crops, not necessarily in terms of safety but because multinational corporations, like Monsanto, own and benefit from applications of the technology. Accordingly, intellectual property issues may also be an important factor for some consumers. A product in the public domain is a lot more acceptable to many people than if it's patent-protected. Intellectual property can be an important criterion for acceptability by some consumers.

What questions will the public ask that scientists and developers need to answer? Consumers will need to know what you are doing and you need to have answers that are scientifically accurate, but also understandable to the public. Scientists need to find a way to be true to the science yet provide understandable information that explains the product and clarifies their motivations. What are the potential benefits and who benefits—who are the winners and who are the losers? As scientists, you may not think certain questions are important, but consumers may ask, "What's in it for me? Do I or do others gain anything from this?" Also, "Who is overseeing this, to make sure that adverse effects don't materialize?" Answers to those questions could determine their opinion on many new products.

Transparency and engagement will be crucial to consumer perceptions. Developers and scientists need to be transparent with stakeholders and the public. They need to engage early in the development process and be honest regarding both benefits and risks, if, indeed, there are any associated risks or other externalities. It isn't necessary to be balanced, but all of the information must be provided. You are not necessarily an advocate but you are somebody providing information. You are not like a lawyer in a courtroom trying to prove one side is correct and the other is wrong. If a scientist does this, he or she can lose credibility very fast.

Natural?

Another issue that may come up when discussing the new DNA-editing techniques is, "What is natural?" There may not be a specific scientific definition, but, clearly, the public's perception of what is natural could come into play with their acceptance of DNA-editing techniques. The public may say that some things are natural that scientists would disagree with. As an example, I ask consumers if they have eaten Rio Red grapefruits, and, if so, whether they think that particular fruit is natural. They often say "yes," not realizing that this particular variety of grapefruit was developed by mutation breeding, whereby DNA was broken with X-rays. Some consumers even think that they are organic. Another example is the pluot,[3] which wasn't available in supermarkets when I was growing up. Now they are broadly for sale, yet many people don't realize that it's a plum-apricot hybrid that would not normally arise in nature. It is not a "natural" fruit, but was developed by a biologist through field trials involving simple cross-pollination and isolation of plants in greenhouses.

Addressing Safety and Oversight

There may not be enough information yet to have an opinion on what risks, if any, are associated with particular products made using new DNA-editing techniques. However, if there are potential risks, then those products should have some form of federal oversight. The questions that need to be asked are:

- What are the potential risks, if any, from the process used?
- What are the potential risks, if any, from the products made from that process?
- How does the risk profile compare to other agricultural breeding techniques and products?

The third question is particularly important because risk is not absolute, it's relative.

Regarding government oversight, consumers generally want decisions that are risk/science-based. As stated earlier in this paper, transparency and public participation also will be important. We heard from Peter Whitfield[4] that many federal laws could oversee these new products. If there is a perceived risk or a potential for risk that doesn't fit into the exact legal mandates provided by current laws, however, consumers will expect legal modifications. Consumers believe that the government is there to protect them. On the other hand, the public does not favor overregulation any more than it favors underregulation.

Some of the discussion at this conference has surrounded whether new DNA-editing techniques will lead to new regulations or whether they will be treated under the existing regulations for GE crops. If potential risks are found from using gene-editing technologies that need federal oversight through regulation, it would not be good to apply the current regulatory process used for GE crops. Instead, it would be better to adopt a process that corrects the problems of the current GE-crop regulatory structure in the United States.

[3]Pluots/plumcots and apriums/apriplums are hybrids of the *Prunus* genus.
[4]Pages 217–222.

If there are potential food-safety risks, we should not adopt the FDA's voluntary process. Instead, let's establish a mandatory process to assure the public that crops made from DNA-editing techniques are safe as determined by an independent FDA review. This change is needed for GE crops and if there is a need to regulate products from these new DNA-editing technologies, they should also require a mandatory FDA review process. Similarly, the USDA regulates based on whether a crop is a potential "plant-pest." However, one could not find three scientists in the country, who, as scientific experts, would say that adding one new gene to a corn plant makes that variety a plant pest just because *Agrobacterium* was used as the transformation vector. The reality is that nobody thinks that current GE crops could be "plant pests" and yet we use that legal hook to regulate those GE crops. The USDA regulatory system wastes a lot of time trying to verify something that everybody knows is already a fact. I do think, though, that there are potential risks around using GE crops in a sustainable manner—and perhaps with products made from these new DNA-editing techniques—that need some oversight by USDA and EPA. But let's look at real "potential" risks, such as development of resistant weeds or pests, not whether something could be a "plant pest."

Conclusions

In the end, consumers want safe food. And consumers will adopt food-related technologies if they think they are safe and beneficial. A new ice-cream product involves slow churning, which leads to less fat, and those products fly off the shelf. Consumers are not against technology applied to food as long as they are assured that it is safe. However, I do believe that nonscientific considerations are important to many consumers when talking about food. The factors for acceptance are multidimensional and beyond "Where did the DNA come from?" Consumer viewpoints will continue to be influenced by opinion leaders, some of whom have been against GE crops and may be opposed to gene-editing. So, I call on all of you, to the extent that you are opinion leaders, to be vocal. My organization, CSPI, is an opinion leader, but there are lots of others, including academic institutions, who need to be part of the public discussion.

If there are potential risks from products made with DNA-editing techniques, then we should have regulation to ensure safety. For now, the answer to that question is not yet known. If there are potential risks that need oversight, the goal should be not to treat them like GE crops but instead develop a better risk-based and science-based regulatory process.

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MR. JAFFE is a recognized expert on agricultural biotechnology and biosafety, on which topics he has published numerous articles and reports. He has worked on biosafety regulatory issues in the United States and throughout the world, including in Kenya, Uganda, Tanzania, Ghana, Nigeria, Malawi, South Africa, Indonesia, the Philippines, and Vietnam. He was a member of the secretary of agriculture's Advisory Committee on Agricultural Biotechnology and 21st Century Agriculture from 2003 to 2008, and was reappointed in 2011. He was also a member of the Food and Drug Administration's Veterinary Medicine Advisory Committee from 2004 to 2008. Jaffe earned his BA with high honors from Wesleyan University in biology and government and then received a law degree from Harvard Law School.